What is claimed is:

1. An objective optical element for use in an optical pickup apparatus which is provided with a first light source of a wavelength $\lambda 1$, a second light source of a wavelength $\lambda 2$ ($\lambda 1<\lambda 2$) and a light converging optical system including a magnification changing element and an objective optical element, wherein the light converging optical system converges a light flux from the first light source onto an information recording plane of a first optical information recording medium through a protective substrate having a thickness t1 so that recording and/or reproducing information is conducted for the first optical information recording medium and the light converging optical system converges a light flux from the second light source onto an information recording plane of a second optical information recording medium through a protective substrate having a thickness t2 ($t1 \le t2$) so that recording and/or reproducing information is conducted for the second optical information recording medium, the objective optical element having an optical system magnification m1 for a light flux of the wavelength $\lambda 1$

and the optical system magnification m1 satisfying the following formula:

$$- 1/7 \leq m1 \leq - 1/25$$

$$|m1| < |M1|$$

where M1 is an optical system magnification from the first light source to the first optical information recording medium for a light flux of the wavelength $\lambda 1$ in the optical pickup apparatus, and

the objective optical element comprising on at least one surface:

a common region through which a light flux from the first light source and a light flux from the second light source pass in common so as to form a converged light spot on an information recording plane of the first optical information recording plane and on an information recording plane of the second optical information recording plane respectively; and

an exclusive region through which a light flux from the first light source passes so as to form a converged light spot on an information recording plane of the first optical information recording plane and a light flux from the second light source passes so as not to form a converged light spot

on an information recording plane of the second optical information recording plane;

wherein the exclusive region includes an exclusive diffractive structure having a function to suppress an increase of spherical aberration due to a raise of atmospheric temperature in accordance with a wavelength fluctuation of a light flux of the wavelength $\lambda 1$ when the light flux of the wavelength $\lambda 1$ having passed through the exclusive diffractive structure is converged on an information recording plane of the first information recording medium, and

wherein a light flux of a wavelength $\lambda 2$ having passed through the exclusive diffractive structure intersects with the optical axis at a position different from the position of the converged light spot formed on the information recording plane of the second optical information recording medium.

2. The objective optical element of claim 1, wherein the objective optical element has an optical system magnification m2 for a light flux of the wavelength $\lambda 2$ and the optical system magnification m2 satisfies the following formula:

$$|m1-m2| < 0.5$$

3. The objective optical element of claim 1, wherein the common region includes a common diffractive structure having a correcting function to reduce a difference between a spherical aberration when a light flux of a wavelength $\lambda 1$ having passed trough the common diffractive structure is converged on an information recording plane of the first optical information recording medium through the protective substrate having the thickness t1 and a spherical aberration when a light flux of a wavelength $\lambda 2$ having passed trough the common diffractive structure is converged on an information recording plane of the second optical information recording medium through the protective substrate having the thickness t2 by the change of the diffractive function caused in accordance with a wavelength difference between the wavelength $\lambda 1$ and the wavelength $\lambda 2$.

4. The objective optical element of claim 3, wherein the common region is divided by a stepped portion stepped in the optical axis direction into a first ring-shaped region and a second ring-shaped region around the center on the optical axis, and wherein the first ring-shaped region located closer

to the optical axis includes a refractive surface and the second region located farther from the optical axis includes the common diffractive structure.

5. The objective optical element of claim 4, wherein an edge of the fist ring-shaped region contacting the second ring-shaped region is located closer to the light source side than an edge of the second ring-shaped region contacting the first ring-shaped region.

6. The objective optical element of claim 4, wherein a third ring-shaped region having a refractive surface is provided so as to adjoin the second ring-shaped region at a farther side from the optical axis, and an edge of the second ring-shaped region contacting the third ring-shaped region is located closer to the optical information recording medium side than an edge of the third ring-shaped region contacting the second ring-shaped region.

7. The objective optical element of claim 2, wherein the common diffractive structure has an optical characteristic to make a spherical aberration of a light flux having passed through the common diffractive structure to become more under

when the wavelength of the light source changes to become longer.

8. The objective optical element of claim 4, wherein at the best image position, an optical path length between a light flux of a wavelength $\lambda 1$ having passed through the first ring-shaped region and a light flux of a wavelength $\lambda 1$ having passed through the second ring-shaped region is different by $\lambda 1 \times i$ (i is an integer).

9. The objective optical element of claim 6, wherein at the best image position, an optical path length between a light flux of a wavelength $\lambda 1$ having passed through the second ring-shaped region and a light flux of a wavelength $\lambda 1$ having passed through the third ring-shaped region is different by $\lambda 1 \times i$ (i is an integer).

10. The objective optical element of claim 3, wherein the diffractive structure is provided on the entire surface of the common region.

11. The objective optical element of claim 1, wherein the common region is divided into a plurality of ring-shaped refractive zones of first, second, · · · k-th ring-shaped refractive zones (k is a natural number larger than 2) arranged in this order from the optical axis, wherein at least n-th ring-shaped refractive zone (n is a natural number, $2 < n \leq k$) has a first edge closer to the optical axis and a second edge farther from the optical axis arranged such that the first edge is positioned at the optical information recording medium side along the optical axis than the second edge and the second edge is positioned at the optical information recording medium side along the optical axis than a first edge of (n+1)-th ring-shaped refractive zone closer to the optical axis, provided that in the case of k=n, the first edge of (n+1)-th ring-shaped refractive zone is an edge of the exclusive region, and wherein a light flux of a wavelength $\lambda 1$ having passed through the n-th ring-shaped refractive zone is converged at a position different from the best image forming position in the optical axis direction.

12. The objective optical element of claim 11, wherein at the best image position, an optical path length between a

light flux of a wavelength $\lambda 1$ having passed through the n-th ring-shaped refractive zone and a light flux of a wavelength $\lambda 1$ having passed through the (n-1)-th ring-shaped refractive zone is different by $\lambda 1 \times i$ (i is an integer).

13. The objective optical element of claim 11, wherein the diffractive structure of the exclusive region has a function of temperature correction.

14. The objective optical element of claim 1, wherein at least a part of the common region has a correcting function to reduce a difference between a spherical aberration when a light flux of a wavelength $\lambda 1$ having passed trough the common region is converged on an information recording plane of the first optical information recording medium through the protective substrate having the thickness t1 and a spherical aberration when a light flux of a wavelength $\lambda 2$ having passed trough the common region is converged on an information recording plane of the second optical information recording medium through the protective substrate having the thickness t2 in accordance with a wavelength difference between the wavelength $\lambda 1$ and the wavelength $\lambda 2$.

15. The objective optical element of claim 1, wherein the magnification changing element is a coupling lens.

16. The objective optical element of claim 1, wherein the objective optical element is an objective lens.

17. The objective optical element of claim 1, wherein the objective optical element is made of a plastic.

18. The objective optical element of claim 1, wherein the first light source and the second light source are arranged on the same base plate.

19. The objective optical element of claim 1, wherein the first light source and the second light source are arranged to have an equal distance along the optical axis from the magnification changing element.

20. An optical pickup apparatus, comprising:

a first light source of a wavelength $\lambda 1$;

a second light source of a wavelength $\lambda 2$ ($\lambda 1 < \lambda 2$); and

a light converging optical system including a magnification changing element and an objective optical element, wherein the light converging optical system converges a light flux from the first light source onto an information recording plane of a first optical information recording medium through a protective substrate having a thickness t1 so that recording and/or reproducing information is conducted for the first optical information recording medium and the light converging optical system converges a light flux from the second light source onto an information recording plane of a second optical information recording medium through a protective substrate having a thickness t2 ($t1 \leq t2$) so that recording and/or reproducing information is conducted for the second optical information recording medium,

the objective optical element having an optical system magnification m1 for a light flux of the wavelength $\lambda1$ and the optical system magnification m1 satisfying the following formula:

$$-1/7 \leq m1 \leq -1/25$$

$$|m1| < |M1|$$

where M1 is an optical system magnification from the first light source to the first optical information recording medium for a light flux of the wavelength $\lambda 1$ in the optical pickup apparatus, and

the objective optical element comprising on at least one surface:

a common region through which a light flux from the first light source and a light flux from the second light source pass in common so as to form a converged light spot on an information recording plane of the first optical information recording plane and on an information recording plane of the second optical information recording plane respectively; and

an exclusive region through which a light flux from the first light source passes so as to form a converged light spot on an information recording plane of the first optical information recording plane and a light flux from the second light source passes so as not to form a converged light spot on an information recording plane of the second optical information recording plane;

wherein the exclusive region includes an exclusive diffractive structure having a function to suppress an increase of spherical aberration due to a raise of

atmospheric temperature in accordance with a wavelength fluctuation of a light flux of the wavelength $\lambda 1$ when the light flux of the wavelength $\lambda 1$ having passed through the exclusive diffractive structure is converged on an information recording plane of the first information recording medium, and

wherein a light flux of a wavelength $\lambda 2$ having passed through the exclusive diffractive structure intersects with the optical axis at a position different from the position of the converged light spot formed on the information recording plane of the second optical information recording medium.

21. The optical pickup apparatus of claim 20, wherein the objective optical element has an optical system magnification m2 for a light flux of the wavelength $\lambda 2$ and the optical system magnification m2 satisfies the following formula:

$$|m1-m2| < 0.5$$

22. The optical pickup apparatus of claim 20, wherein the common region includes a common diffractive structure having a correcting function to reduce a difference between a spherical aberration when a light flux of a wavelength $\lambda 1$

having passed trough the common diffractive structure is converged on an information recording plane of the first optical information recording medium through the protective substrate having the thickness t1 and a spherical aberration when a light flux of a wavelength $\lambda 2$ having passed trough the common diffractive structure is converged on an information recording plane of the second optical information recording medium through the protective substrate having the thickness t2 by the change of the diffractive function caused in accordance with a wavelength difference between the wavelength $\lambda 1$ and the wavelength $\lambda 2$.

23. The optical pickup apparatus of claim 22, wherein the common region is divided by a stepped portion stepped in the optical axis direction into a first ring-shaped region and a second ring-shaped region around the center on the optical axis, and wherein the first ring-shaped region located closer to the optical axis includes a refractive surface and the second region located farther from the optical axis includes the common diffractive structure.

24. The optical pickup apparatus of claim 23, wherein an edge of the fist ring-shaped region contacting the second ring-shaped region is located closer to the light source side than an edge of the second ring-shaped region contacting the first ring-shaped region.

25. The optical pickup apparatus of claim 23, wherein a third ring-shaped region having a refractive surface is provided so as to adjoin the second ring-shaped region at a farther side from the optical axis, and an edge of the second ring-shaped region contacting the third ring-shaped region is located closer to the optical information recording medium side than an edge of the third ring-shaped region contacting the second ring-shaped region.

26. The optical pickup apparatus of claim 22, wherein the common diffractive structure has an optical characteristic to make a spherical aberration of a light flux having passed through the common diffractive structure to become more under when the wavelength of the light source changes to become longer.

27. The optical pickup apparatus of claim 23, wherein at the best image position, an optical path length between a light flux of a wavelength $\lambda 1$ having passed through the first ring-shaped region and a light flux of a wavelength $\lambda 1$ having passed through the second ring-shaped region is different by $\lambda 1 x i$ (i is an integer).

28. The optical pickup apparatus of claim 25, wherein at the best image position, an optical path length between a light flux of a wavelength $\lambda 1$ having passed through the second ring-shaped region and a light flux of a wavelength $\lambda 1$ having passed through the third ring-shaped region is different by $\lambda 1 x i$ (i is an integer).

29. The optical pickup apparatus of claim 22, wherein the diffractive structure is provided on the entire surface of the common region.

30. The optical pickup apparatus of claim 20, wherein the common region is divided into a plurality of ring-shaped refractive zones of first, second, · · · k-th ring-shaped refractive zones (k is a natural number larger than 2)

arranged in this order from the optical axis, wherein at least n-th ring-shaped refractive zone (n is a natural number, $2 < n \leq k$) has a first edge closer to the optical axis and a second edge farther from the optical axis arranged such that the first edge is positioned at the optical information recording medium side along the optical axis than the second edge and the second edge is positioned at the optical information recording medium side along the optical axis than a first edge of (n+1)-th ring-shaped refractive zone closer to the optical axis, provided that in the case of k=n, the first edge of (n+1)-th ring-shaped refractive zone is an edge of the exclusive region, and wherein a light flux of a wavelength $\lambda 1$ having passed through the n-th ring-shaped refractive zone is converged at a position different from the best image forming position in the optical axis direction.

31. The optical pickup apparatus of claim 30, wherein at the best image position, an optical path length between a light flux of a wavelength $\lambda 1$ having passed through the n-th ring-shaped refractive zone and a light flux of a wavelength $\lambda 1$ having passed through the (n-1)-th ring-shaped refractive zone is different by $\lambda 1 \times i$ (i is an integer).

32. The optical pickup apparatus of claim 30, wherein the diffractive structure of the exclusive region has a function of temperature correction.

33. The optical pickup apparatus of claim 20, wherein at least a part of the common region has a correcting function to reduce a difference between a spherical aberration when a light flux of a wavelength $\lambda 1$ having passed trough the common region is converged on an information recording plane of the first optical information recording medium through the protective substrate having the thickness t1 and a spherical aberration when a light flux of a wavelength $\lambda 2$ having passed trough the common region is converged on an information recording plane of the second optical information recording medium through the protective substrate having the thickness t2 in accordance with a wavelength difference between the wavelength $\lambda 1$ and the wavelength $\lambda 2$.

34. The optical pickup apparatus of claim 20, wherein the magnification changing element is a coupling lens.

35. The optical pickup apparatus of claim 20, wherein the objective optical element is an objective lens.

36. The optical pickup apparatus of claim 20, wherein the objective optical element is made of a plastic.

37. The optical pickup apparatus of claim 20, wherein the first light source and the second light source are arranged on the same base plate.

38. The optical pickup apparatus of claim 20, wherein the first light source and the second light source are arranged to have an equal distance along the optical axis from the magnification changing element.

39. An optical pickup apparatus, comprising:

a first light source to emit a light flux having a first wavelength $\lambda 1$;

a second light source to emit a light flux having a second wavelength $\lambda 2$ ($\lambda 1<\lambda 2$);

a plurality of optical elements including an objective optical element,

wherein the optical pickup apparatus conducts reproducing and/or recording information by converging a light flux having the first wavelength $\lambda 1$ onto a first optical information recording medium provided with a protective substrate having a thickness t1 and by converging a light flux having the second wavelength $\lambda 2$ onto a second optical information recording medium provided with a protective substrate having a thickness t2 ($t1 \leq t2$);

wherein at least one optical element of the plurality of optical elements has at least two regions of a central region having a center on the optical axis and a peripheral region located at a periphery of the central region on at least one optical surface;

wherein on the central region, step-shaped discontinuous sections having the predetermined number of steps are formed periodically concentrically around the optical axis so that the central region is equipped with a phase modulating structure to provide a phase difference to at least one of a light flux of the wavelength $\lambda 1$ and a light flux of the wavelength $\lambda 2$ and to converge the light flux provided with the phase difference onto a predetermined optical information recording medium on a condition that a

spherical aberration and/or a wavefront aberration is corrected in cooperation with the objective optical element, and

wherein the both of a light flux having the first wavelength $\lambda 1$ and a light flux having the second wavelength $\lambda 2$ come as a divergent light flux into the objective optical element.

40. The optical pickup apparatus of claim 39, wherein the period of the step-shaped discontinuous sections is represented by an integer portion of $(\phi(h)/2\pi)$, where $\phi(h)$ is a phase function defined by the formula:

$$\phi(h)=(B_2h^2+ B_4h^4+B_6h^6+\cdot\cdot B_nh^n)\times 2\pi$$

by using a height h from the optical axis and the coefficient B_n of n-th order optical path difference function (n is an even number), and the following formula is satisfied:

$$0 \leq |\phi(h_{in})/2\pi-B_2(h_{in})^2| \leq 10$$

where B_2 is a coefficient of second order optical path difference and h_{in} is a height from the optical axis to a position located farthest from the optical axis in the central region.

41. The optical pickup apparatus of claim 40, wherein the following formula is satisfied:

$$|B_2(h_{in})^2| \leq 18$$

42. The optical pickup apparatus of claim 39, wherein among a light flux having the second wavelength $\lambda 2$, a light flux having passed through the central region is converged on an information recording plane of the second information recording medium and a light flux having passed through the peripheral region is converged out of an information recording plane of the second information recording medium.

43. The optical pickup apparatus of claim 39, wherein the peripheral region comprises a refractive structure to refract a light flux.

44. The optical pickup apparatus of claim 39, wherein the peripheral region comprises a phase modulating structure similar to the phase modulating structure formed on the central region.

45. The optical pickup apparatus of claim 39, wherein the peripheral region comprises a phase modulating structure similar to the phase modulating structure formed on the central region.

46. The optical pickup apparatus of claim 39, wherein the peripheral region comprises saw teeth-shaped diffractive ring-shaped zones.

47. The optical pickup apparatus of claim 39, wherein the peripheral region comprises step-shaped discontinuous sections on a prescribed aspherical surface and the step-shaped discontinuous sections are shifted respectively in parallel to the optical axis.

48. The optical pickup apparatus of claim 39, wherein the step-shaped discontinuous sections provided on the phase modulating structure of the central region has plural step-shaped discontinuous sections and the number of steps of at least one of the plural step-shaped discontinuous sections is 4.

49. The optical pickup apparatus of claim 39, wherein the step-shaped discontinuous sections provided on the phase modulating structure of the central region has plural step-shaped discontinuous sections and the number of steps of at least one of the plural step-shaped discontinuous sections is 5.

50. The optical pickup apparatus of claim 39, wherein the following formulas are satisfied:

$$620\ nm \leq \lambda 1 \leq 680\ nm$$

$$750\ nm \leq \lambda 2 \leq 810\ nm$$

51. The optical pickup apparatus of claim 39, wherein the phase modulating structure is formed on an optical element other than the objective optical element.

52. The optical pickup apparatus of claim 39, wherein the phase modulating structure is formed on the objective optical element.

53. The optical pickup apparatus of claim 39, wherein an optical system magnification m satisfies the following formula:

$$- 0.149 \leq m \leq -0.049$$

54. The optical pickup apparatus of claim 39, wherein the phase modulating structure on the central region does not provide a phase difference for a light flux having the first wavelength $\lambda 1$ or regulate the absolute value of a phase difference provided by the depth of each step of the step-shaped discontinuous sections smaller than 2π radian.

55. The optical pickup apparatus of claim 39, wherein the phase modulating structure on the central region does not provide a phase difference for a light flux having the second wavelength $\lambda 2$ or regulate the absolute value of a phase difference provided by the depth of each step of the step-shaped discontinuous sections smaller than 2π radian.

56. The optical pickup apparatus of claim 39, wherein the number of the step-shaped discontinuous sections provided to

the phase modulating structure of the central region is 3 to 18.

57. The optical pickup apparatus of claim 39, wherein the phase modulating structure is provided on plural optical surfaces of one of the optical element.

58. The optical pickup apparatus of claim 39, wherein the following structure is satisfied:

$$-3.2 < R2/R1 < -1.9$$

59. An objective lens for use in an optical pickup apparatus which is provided with a first light source to emit a light flux having a first wavelength $\lambda 1$; a second light source to emit a light flux having a second wavelength $\lambda 2$ ($\lambda 1<\lambda 2$); a plurality of optical elements, wherein the optical pickup apparatus conducts reproducing and/or recording information by converging a light flux having the first wavelength $\lambda 1$ onto a first optical information recording medium provided with a protective substrate having a thickness t1 and by converging a light flux having the second wavelength $\lambda 2$ onto a second optical information recording

medium provided with a protective substrate having a thickness t2 ($t1 \leq t2$); the objective optical element comprising:

at least two regions of a central region having a center on the optical axis and a peripheral region located at a periphery of the central region on at least one optical surface;

wherein on the central region, step-shaped discontinuous sections having the predetermined number of steps are formed periodically concentrically around the optical axis so that the central region is equipped with a phase modulating structure to provide a phase difference to at least one of a light flux of the wavelength $\lambda1$ and a light flux of the wavelength $\lambda2$ and to converge the light flux provided with the phase difference onto a predetermined optical information recording medium on a condition that a spherical aberration and/or a wavefront aberration is corrected in cooperation with the objective optical element, and

wherein the both of a light flux having the first wavelength $\lambda1$ and a light flux having the second wavelength

$\lambda 2$ come as a divergent light flux into the objective optical element.

60. A light converging optical system for converging a light flux having a first wavelength $\lambda 1$ (630 nm $\leq \lambda 1 \leq$ 680 nm) on an information recording plane of a first optical information recording medium equipped with a protective substrate having a thickness t1 and for converging a light flux having a second wavelength $\lambda 2$ (680 nm $\leq \lambda 2 \leq$ 760 nm) on an information recording plane of a second optical information recording medium equipped with a protective substrate having a thickness t2 (t1 < t2), comprising:

an optical element section including at least an objective optical element and having one optical element or a plurality of optical elements;

the objective optical element having an optical magnification m1 (m1 $\neq$ 0) for a light flux having the first wavelength $\lambda 1$ and an optical magnification m2 (m2 $\neq$ 0) for a light flux having the first wavelength $\lambda 2$;

the optical element section having a common region on at least one optical surface, wherein a light flux of the wavelength $\lambda 1$ passes through the common region and the light

flux of the wavelength $\lambda 1$ having passed through the common region is converged on the information recording plane of the first optical information recording medium and a light flux of the wavelength $\lambda 2$ passes through the common region and the light flux of the wavelength $\lambda 2$ having passed through the common region is converged on the information recording plane of the second optical information recording medium;

a ring-shaped structure formed on the common region in which the ring-shaped structure includes a plurality of ring-shaped optical functional surfaces having a center on the optical axis and neighboring ring-shaped optical functional surfaces are jointed through a stepped surface, wherein the length x of the stepped surfaces parallel to the optical axis satisfies the following formula:

$$5.5\ \mu m \leq x \leq 7\ \mu m$$

61. The light converging optical system of claim 60, wherein the number of the plurality of ring-shaped optical functional surfaces is 4 to 60.

62. The light converging optical system of claim 60, wherein the optical element having the common region is a coupling lens.

63. The light converging optical system of claim 60, wherein the optical element having the common region is a objective optical element.

64. The light converging optical system of claim 60, wherein the optical system magnification m1 satisfies the following formula:

$$-1/3 \leq m1 \leq 0$$

65. The light converging optical system of claim 60, wherein the optical system magnification m2 satisfies the following formula:

$$-1/3 \leq m2 \leq 0$$

66. The light converging optical system of claim 60, wherein the focal length f1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$$f1 \leq 4 \text{ mm}$$

67. The light converging optical system of claim 60, wherein the focal length f1 for a light flux having the second wavelength $\lambda 2$ satisfies the following formula:

$$f1 \le 4 \text{ mm}$$

68. The light converging optical system of claim 60, wherein the image side numerical aperture NA1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$$0.55 \le NA1 \le 0.67$$

69. The light converging optical system of claim 60, wherein the image side numerical aperture NA2 for a light flux having the second wavelength $\lambda 2$ satisfies the following formula:

$$0.44 \le NA2 \le 0.55$$

70. The light converging optical system of claim 60, wherein the ring-shaped structure is a diffractive structure.

71. The light converging optical system of claim 70, wherein the order number K1 of a diffracted light ray having

the maximum diffraction efficiency among diffracted light rays of the wavelength λ1 diffracted by the diffractive structure is 5, and the order number K2 of a diffracted light ray having the maximum diffraction efficiency among diffracted light rays of the wavelength λ2 diffracted by the diffractive structure is 4.

72. The light converging optical system of claim 60, wherein each of a light flux of the wavelength λ1 and a light flux of the wavelength λ2 having passed through the ring-shaped structure goes out in a direction to be refracted by the ring-shaped optical functional surfaces.

73. An optical pickup apparatus, comprising:

a first light source to emit a light flux of the wavelength λ1;

a second light source to emit a light flux of the wavelength λ2; and

the light converging optical system described in claim 60;

wherein the optical pickup apparatus conducts at least one of recording and reproducing by converging a light flux

of the wavelength $\lambda 1$ emitted from the first light source on an information recording plane of the first optical information recording medium by the light converging system and conducts at least one of recording and reproducing by converging a light flux of the wavelength $\lambda 2$ emitted from the second light source on an information recording plane of the second optical information recording medium by the light converging system.

74. The optical pickup apparatus of claim 73, wherein the first light source and the second light source are integrated in one body.

75. An optical pickup apparatus, comprising:

a first light source to emit a light flux of a wavelength $\lambda 1$ (630 nm $\le \lambda 1 \le$ 680 nm);

a second light source to emit a light flux of a wavelength $\lambda 2$ (760 nm $\le \lambda 2 \le$ 810 nm); and

a light converging optical system having a plurality of optical elements including an objective optical element for converging a light flux having the first wavelength $\lambda 1$ on an information recording plane of a first optical information

recording medium equipped with a protective substrate having a thickness t1 and for converging a light flux having the second wavelength $\lambda 2$ on an information recording plane of a second optical information recording medium equipped with a protective substrate having a thickness t2 ($t1 < t2$) so that the optical pickup apparatus conducts reproducing and/or recording information;

the objective optical element having an optical magnification m1 ($m1 \neq 0$) for a light flux having the first wavelength $\lambda 1$ and an optical magnification m2 ($m2 \neq 0$) for a light flux having the first wavelength $\lambda 2$;

at least one of the plurality of optical elements having a common region on at least one optical surface on which a ring-shaped structure including a plurality of ring-shaped optical functional surfaces having a center on the optical axis is formed and neighboring ring-shaped optical functional surfaces are jointed through a stepped surface, wherein the common region converges a refracted light ray of a light flux having the first wavelength $\lambda 1$ and a refracted light ray of a light flux having the second wavelength $\lambda 2$ caused by the plurality of ring-shaped optical functional

surfaces on an information recording plane of respective optical information recording mediums;

wherein the following formula is satisfied:

$0.8 \times COMA_2 \leq COMA_1 \leq 1.2 \times COMA_2$

where $COMA_1$ is a coma aberration ($\lambda 1$rms) of a wavefront aberration of a converged light spot formed on an information recording plane of the first information recording medium by a light flux of the first wavelength $\lambda 1$ coming with an inclination angle of 1° into the light converging optical system and $COMA_2$ is a coma aberration ($\lambda 2$rms) of a wavefront aberration of a converged light spot formed on an information recording plane of the second information recording medium by a light flux of the second wavelength $\lambda 2$ coming with an inclination angle of 1° into the light converging optical system, provided that $COMA_i$ = ((the third order coma aberration when the wavefron aberration of a light flux of a i-th wavelength λi is represented by Zernike's polynomial)^2 + (the fifth order coma aberration when the wavefron aberration of a light flux of a i-th wavelength λi is represented by Zernike's polynomial)^2)$^{1/2}$ (i = 1 or 2)

76. The optical pickup apparatus of claim 75, where the number of the plurality of ring-shaped optical functional surfaces 4 to 30.

77. The optical pickup apparatus of claim 75, wherein the optical element having the common region is a coupling lens.

78. The optical pickup apparatus of claim 75, wherein the optical element having the common region is a objective optical element.

79. The optical pickup apparatus of claim 75, wherein the first light source and the second light source are integrated in one body.

80. The 1 optical pickup apparatus of claim 75, wherein the optical system magnification m1 satisfies the following formula:

$$-1/3 \leq m1 \leq 0$$

81. The optical pickup apparatus of claim 75, wherein the optical system magnification m2 satisfies the following formula:

$- 1/3 \leq m2 \leq 0$

82. The optical pickup apparatus of claim 75, wherein the focal length f1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$f1 \leq 4$ mm

83. The optical pickup apparatus of claim 75, wherein the focal length f1 for a light flux having the second wavelength $\lambda 2$ satisfies the following formula:

$f1 \leq 4$ mm

84. The optical pickup apparatus of claim 75, wherein the image side numerical aperture NA1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$0.55 \leq NA1 \leq 0.67$

85. The optical pickup apparatus of claim 75, wherein the image side numerical aperture NA2 for a light flux having the second wavelength $\lambda 2$ satisfies the following formula:

$0.44 \leq NA2 \leq 0.55$

86. The optical pickup apparatus of claim 75, wherein the following formula is satisfied:

$COMA_1 \leq 0.040$ (λ1rms)

87. The optical pickup apparatus of claim 75, wherein the following formula is satisfied:

$COMA_2 \leq 0.040$ (λ2rms)

88. The optical pickup apparatus of claim 75, wherein the following formula is satisfied:

$0.2 \times 2\pi \leq P1$

$0.2 \times 2\pi \leq P2$

where P1 is a phase difference caused when a light flux of the first wavelength $\lambda 1$ passes through the ring-shaped optical functional surfaces, and P1 is a phase difference caused when a light flux of the second wavelength $\lambda 2$ passes through the ring-shaped optical functional surfaces.

89. A light converging optical system for use in an optical pickup apparatus which is provided with a first light source to emit a light flux of a wavelength $\lambda 1$ (630 nm $\leq \lambda 1 \leq$ 680

nm); a second light source to emit a light flux of a wavelength $\lambda 2$ (760 nm $\leq \lambda 2 \leq$ 810 nm), comprising:

a plurality of optical elements including an objective optical element for converging a light flux having the first wavelength $\lambda 1$ on an information recording plane of a first optical information recording medium equipped with a protective substrate having a thickness t1 and for converging a light flux having the second wavelength $\lambda 2$ on an information recording plane of a second optical information recording medium equipped with a protective substrate having a thickness t2 ($t1 < t2$) so that the optical pickup apparatus conducts reproducing and/or recording information;

the objective optical element having an optical magnification m1 ($m1 \neq 0$) for a light flux having the first wavelength $\lambda 1$ and an optical magnification m2 ($m2 \neq 0$) for a light flux having the first wavelength $\lambda 2$;

at least one of the plurality of optical elements having a common region on at least one optical surface on which a ring-shaped structure including a plurality of ring-shaped optical functional surfaces having a center on the optical axis is formed and neighboring ring-shaped optical functional surfaces are jointed through a stepped surface,

wherein the common region converges a refracted light ray of a light flux having the first wavelength λ1 and a refracted light ray of a light flux having the second wavelength λ2 caused by the plurality of ring-shaped optical functional surfaces on an information recording plane of respective optical information recording mediums;

wherein the following formula is satisfied:

$0.8 \times COMA_2 \leq COMA_1 \leq 1.2 \times COMA_2$

where $COMA_1$ is a coma aberration (λ1rms) of a wavefront aberration of a converged light spot formed on an information recording plane of the first information recording medium by a light flux of the first wavelength λ1 coming with an inclination angle of 1° into the light converging optical system and $COMA_2$ is a coma aberration (λ2rms) of a wavefront aberration of a converged light spot formed on an information recording plane of the second information recording medium by a light flux of the second wavelength λ2 coming with an inclination angle of 1° into the light converging optical system, provided that $COMA_i$ = ((the third order coma aberration when the wavefron aberration of a light flux of a i-th wavelength λi is represented by Zernike's polynomial)^2 + (the fifth order coma aberration when the wavefron aberration

of a light flux of a i-th wavelength λi is represented by Zernike's polynomial$)^{2})^{1/2}$ (i = 1 or 2)

90. The light converging optical system of claim 89, where the number of the plurality of ring-shaped optical functional surfaces 4 to 30.

91. The light converging optical system of claim 89, wherein the optical element having the common region is a coupling lens.

92. The light converging optical system of claim 89, wherein the optical element having the common region is a objective optical element.

93. The light converging optical system of claim 89, wherein the first light source and the second light source are integrated in one body.

94. The l light converging optical system of claim 89, wherein the optical system magnification m1 satisfies the following formula:

$$-1/3 \le m1 \le 0$$

95. The light converging optical system of claim 89, wherein the optical system magnification m2 satisfies the following formula:

$$- 1/3 \le m2 \le 0$$

96. The light converging optical system of claim 89, wherein the focal length f1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$$f1 \le 4 \text{ mm}$$

97. The light converging optical system of claim 89, wherein the focal length f1 for a light flux having the second wavelength $\lambda 2$ satisfies the following formula:

$$f1 \le 4 \text{ mm}$$

98. The light converging optical system of claim 89, wherein the image side numerical aperture NA1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$$0.55 \le NA1 \le 0.67$$

99. The light converging optical system of claim 89, wherein the image side numerical aperture NA2 for a light flux having the second wavelength λ2 satisfies the following formula:

$$0.44 \le NA2 \le 0.55$$

100. The light converging optical system of claim 89, wherein the following formula is satisfied:

$$COMA_1 \le 0.040\ (\lambda 1 rms)$$

101. The light converging optical system of claim 89, wherein the following formula is satisfied:

$$COMA_2 \le 0.040\ (\lambda 2 rms)$$

102. The light converging optical system of claim 89, wherein the following formula is satisfied:

$$0.2 x 2\pi \le P1$$

$$0.2 x 2\pi \le P2$$

where P1 is a phase difference caused when a light flux of the first wavelength λ1 passes through the ring-shaped optical functional surfaces, and P1 is a phase difference

caused when a light flux of the second wavelength $\lambda 2$ passes through the ring-shaped optical functional surfaces.

103. An objective optical element for use in an optical pickup apparatus which is provided with a first light source to emit a light flux of a wavelength $\lambda 1$ (630 nm $\leq \lambda 1 \leq$ 680 nm); a second light source to emit a light flux of a wavelength $\lambda 2$ (760 nm $\leq \lambda 2 \leq$ 810 nm), and a plurality of optical elements including an objective optical element for converging a light flux having the first wavelength $\lambda 1$ on an information recording plane of a first optical information recording medium equipped with a protective substrate having a thickness t1 and for converging a light flux having the second wavelength $\lambda 2$ on an information recording plane of a second optical information recording medium equipped with a protective substrate having a thickness t2 (t1 < t2) so that the optical pickup apparatus conducts reproducing and/or recording information,

the objective optical element having an optical magnification m1 (m1 $\neq$ 0) for a light flux having the first wavelength $\lambda 1$ and an optical magnification m2 (m2 $\neq$ 0) for a light flux having the first wavelength $\lambda 2$;

the objective optical element comprising a common region on at least one optical surface on which a ring-shaped structure including a plurality of ring-shaped optical functional surfaces having a center on the optical axis is formed and neighboring ring-shaped optical functional surfaces are jointed through a stepped surface, wherein the common region converges a refracted light ray of a light flux having the first wavelength λ1 and a refracted light ray of a light flux having the second wavelength λ2 caused by the plurality of ring-shaped optical functional surfaces on an information recording plane of respective optical information recording mediums;

wherein the following formula is satisfied:

$$0.8 \times COMA_2 \leq COMA_1 \leq 1.2 \times COMA_2$$

where $COMA_1$ is a coma aberration (λ1rms) of a wavefront aberration of a converged light spot formed on an information recording plane of the first information recording medium by a light flux of the first wavelength λ1 coming with an inclination angle of 1° into the light converging optical system and $COMA_2$ is a coma aberration (λ2rms) of a wavefront aberration of a converged light spot formed on an information recording plane of the second information recording medium by

a light flux of the second wavelength $\lambda 2$ coming with an inclination angle of 1° into the light converging optical system, provided that $COMA_i$ = ((the third order coma aberration when the wavefron aberration of a light flux of a i-th wavelength λi is represented by Zernike's polynomial)^2 + (the fifth order coma aberration when the wavefron aberration of a light flux of a i-th wavelength λi is represented by Zernike's polynomial)^2)$^{1/2}$ (i = 1 or 2)

104. The objective optical element of claim 103, where the number of the plurality of ring-shaped optical functional surfaces 4 to 30.

105. The objective optical element of claim 103, wherein the first light source and the second light source are integrated in one body.

106. The 1 objective optical element of claim 103, wherein the optical system magnification m1 satisfies the following formula:

$$-1/3 \leq m1 \leq 0$$

107. The objective optical element of claim 103, wherein the optical system magnification m2 satisfies the following formula:

$$-1/3 \leq m2 \leq 0$$

108. The objective optical element of claim 103, wherein the focal length f1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$$f1 \leq 4 \text{ mm}$$

109. The objective optical element of claim 103, wherein the focal length f1 for a light flux having the second wavelength $\lambda 2$ satisfies the following formula:

$$f1 \leq 4 \text{ mm}$$

110. The objective optical element of claim 103, wherein the image side numerical aperture NA1 for a light flux having the first wavelength $\lambda 1$ satisfies the following formula:

$$0.55 \leq NA1 \leq 0.67$$

111. The objective optical element of claim 103, wherein the image side numerical aperture NA2 for a light flux having the second wavelength λ2 satisfies the following formula:

$$0.44 \leq NA2 \leq 0.55$$

112. The objective optical element of claim 103, wherein the following formula is satisfied:

$$COMA_1 \leq 0.040\ (\lambda 1 rms)$$

113. The objective optical element of claim 103, wherein the following formula is satisfied:

$$COMA_2 \leq 0.040\ (\lambda 2 rms)$$

114. The objective optical element of claim 103, wherein the following formula is satisfied:

$$0.2 \times 2\pi \leq P1$$

$$0.2 \times 2\pi \leq P2$$

where P1 is a phase difference caused when a light flux of the first wavelength λ1 passes through the ring-shaped optical functional surfaces, and P1 is a phase difference caused when a light flux of the second wavelength λ2 passes through the ring-shaped optical functional surfaces.